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EXECUTIVE SUMMARY

BOOTH QUARRY GROUND WATER MONITORING JUNE, 1984

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Regular monitoring of Booth Quarry fly ash disposal site, Etobicoke, which was initiated in 1976 at the request of the Ontario Ministry of Environment, was continued in 1984. A major decrease (first observed in November, 1982) persists in concentrations of dissolved components of ground water in the central sump, where small shifts in major ion chemistry have been observed; these changes cannot be attributed to simple dilution and remain anomalous for the present. There has been little significant change in water chemistry for the peripheral wells at the site. A piezometric head survey shows that the water table remains fairly steady; the central sump water elevation is slightly lower than those in the other wells. Monitoring continues.

job	file	date	report no.
740631-154-892	837.71	January 7, 1985	84-389-K

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BOOTH QUARRY GROUND WATER MONITORING
JUNE, 1984

A. Golomb

A major decrease (first observed in November, 1982) persists in concentrations of dissolved components of ground water sampled from the central sump, where slight shifts in major ion chemistry have been observed. Water chemistry for other observation wells at the site has undergone little significant change. Piezometric head measurements show that the water table remains fairly steady. Monitoring continues.

Ground water samples were taken from the central sump and four peripheral monitoring wells at Booth Quarry ash disposal site, Etobicoke, on June 13, 1984. Sampling locations are shown in Figure 1. Analytical results are given in Table I, and major ion balances are given in Tables II - VIII. A Piper trilinear diagram (Figure 2) for all locations sampled on June 13, 1984, shows that ground waters taken from the central sump, OW-1-82 and OW-6-82 have no dominance of major ions, while ground waters from OW-2-77 and OW-8-77 lie in the region of dominance of alkaline earths and weak acid anions. Piper diagrams (Figure 3-7) for individual observation wells contain historic data for each. Generally there has been little change in major ion chemistry at the site since the previous sampling (November, 1983)/1/, with one exception - a return of the central sump major ion chemistry from the region of dominance of alkaline earths and weak acid anions (characteristic of the samplings of June and November, 1983) back into the region of no dominance that was characteristic of the sump from 1976 to November 1982. The Piper diagrams show no significant change for observation wells OW-1-82 and OW-6-82 (each of which continues to show no dominance of major ions).

job	file	date	report no.
740631-154-892	837.71	January 7, 1985	84-389-K

Chemical characteristics of central sump water reflect continuation of a major (~20:1) dilution which occurred following the sampling of June, 1982, when concentrations of most components decreased to levels below those reported/2/ for Lake Ontario water. It has been suggested/3/ that the observed dilution might have resulted from infiltration of precipitation and run-off through the still uncovered fly ash fill surrounding the central sump. As noted above, the temporary shift of central sump major ion water chemistry out of the region of 'no dominance' in 1983 has been reversed in 1984. Such a change cannot be accounted for by simple dilution and is, for the present, anomalous.

The concentration of zinc in the central sump notably rose from <0.02 mg/L (in November, 1983) to 3.9 mg/L in June, 1984. This may reflect continuing corrosion of the galvanized well casing, resulting in excursions of zinc levels above the detection limit, as has been observed intermittently throughout the monitoring programme which began in 1976.

The 1983-84 piezometric head survey (Table VII) shows little overall change in the water table since the last measurement except that the level in the central sump increased by ~1 m above the preceding level. However, levels in the other observation wells remain fairly steady, at levels generally above that in the sump. There is no obvious correlation between the level in the central sump and the major dilution first observed there in November, 1982. Monitoring continues.

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REFERENCES

1. Research Division Report No 84-25-K.
2. Ontario MOE, 1978. Unpublished data.
3. Research Division Report No 83-15-K.

TABLE I

CHARACTERISTICS OF GROUNDWATERS AT BOOTH QUARRY ASH DISPOSAL SITE
JUNE 13, 1984

	Central Sump	OW-1-82	OW-2-77	OW-6-82	OW-8-77
pH	7.1	8.0	7.8	7.7	7.8
Sp Conductivity (mS/m)	22	117	84	134	73
Alkalinity OH^-	<5	<5	<5	<5	<5
as $CO_3^=$	<5	<5	<5	<5	<5
$CaCO_3$ HCO_3^-	41	310	303	352	237
Hardness (as $CaCO_3$)	95	222	423	502	213
Sulphate	44	163	150	316	90
Chloride	13	92	18	58	47
Sodium	9.7	160	32	101	16
Potassium	1.6	15	6	24	4.3
Calcium	35	60	100	128	117
Magnesium	1.9	18	42	44	15
Aluminum	<1	<1	<1	<1	<1
Arsenic	0.001	<0.001	<0.001	<0.001	<0.001
Barium	<2	<2	<2	<2	<2
Boron	0.4	1.9	0.3	2.0	0.2
Cadmium	<0.0001	0.0001	0.0001	0.0001	0.0001
Chromium	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	0.001	0.005	0.002	0.007	0.007
Iron	0.06	<0.05	<0.05	<0.05	<0.05
Lead	<0.002	<0.002	<0.002	<0.002	<0.002
Manganese	0.1	0.5	<0.05	0.25	0.1
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	0.22	1.3	0.64	3.7	0.33
Titanium	<1	<1	<1	<1	<1
Vanadium	<0.005	<0.005	<0.005	0.005	<0.005
Zinc	13.9	0.03	0.05	0.03	<0.02
TDS	150	700	510	830	420

Note: All concentrations given in milligrams per litre.

TABLE II

MAJOR ION CHEMISTRY
BOOTH QUARRY - CENTRAL SUMP

CATIONS

	Ca			Mg			Na			K				
Date	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	CATION TOTAL	ANION TOTAL
June 13, 1984	35	1.75	74	1.9	0.16	7	9.7	0.42	17	1.6	0.04	2	2.33	2.10
Nov 16, 1983	24	1.20	72	2.6	0.21	13	3.0	0.13	8	4.4	0.11	7	1.66	1.66
June 13, 1983	27	1.35	79	2.4	0.20	12	2.9	0.13	8	0.7	0.02	1	1.70	1.73
Nov 16, 1982	25	1.25	77	2.7	0.22	14	3.2	0.14	8	0.7	0.02	1	1.63	1.55
June 16, 1982	370	18.46	51	114	9.37	26	160	6.96	19	54	1.38	4	36.17	32.87
Oct 13, 1981	220	10.98	50	77	6.33	23	190	8.27	38	54	1.38	6	26.96	27.37
June 09, 1981	258	12.87	44	87	7.16	24	188	8.18	28	51	1.30	4	29.51	29.23
June 12, 1980	300	14.96	42	108	8.89	25	240	10.43	29	44	1.13	3	35.41	36.87
Nov 21, 1979	310	15.46	35	95	7.82	18	435	18.91	43	60	1.53	4	43.73	42.89
Sept 12, 1979	390	19.45	39	100	8.23	17	470	20.43	41	60	1.53	3	49.65	48.24
June 06, 1979	230	11.47	36	95	7.82	24	260	11.30	35	60	1.53	5	32.13	32.47
Sept 21, 1978	186	9.28	42	69	5.68	25	169	7.35	33	0	0	0	22.30	21.35
May 06, 1978	130	6.48	41	40	3.29	21	130	5.65	36	18	0.46	3	15.89	15.44
June 10, 1977	370	18.45	34	100	8.23	15	630	27.39	51	0	0	0	54.08	56.27

ANIONS

	Cl			SO_4			HCO_3			CO_3				
Date	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	ANION TOTAL	CATION TOTAL
June 13, 1984	13	0.37	17	44	0.92	44	41	0.82	39	0	0	0	2.10	2.33
Nov 16, 1983	3.0	0.08	5	24	0.50	30	54	1.08	65	0	0	0	1.66	1.66
June 13, 1983	5.0	0.14	8	30	0.63	36	48	0.96	56	0	0	0	1.73	1.70
Nov 16, 1982	4.8	0.14	9	30	0.63	41	39	0.78	50	0	0	0	1.55	1.63
June 16, 1982	160	4.51	14	970	20.18	61	375	7.50	23	34	0.68	2	32.87	36.17
Oct 13, 1981	160	4.51	16	800	16.66	61	378	6.20	23	0	0	0	27.37	26.96
June 09, 1981	166	4.68	16	850	17.00	61	418	6.85	23	0	0	0	29.23	29.51
June 12, 1980	310	8.73	24	1060	22.06	60	371	6.08	16	0	0	0	36.87	35.41
Nov 21, 1979	565	15.92	37	1060	22.06	51	300	4.92	11	0	0	0	42.89	43.73
Sept 12, 1979	840	23.66	49	960	19.98	41	281	4.60	10	0	0	0	48.24	49.65
June 06, 1979	300	8.45	26	770	16.02	49	488	8.00	25	0	0	0	32.47	32.13
Sept 21, 1978	213	6.00	28	308	6.41	30	545	8.94	42	0	0	0	21.35	22.30
May 06, 1978	150	4.23	27	270	5.62	36	342	5.60	36	0	0	0	15.44	15.89
June 10, 1977	1300	36.62	65	170	14.78	26	298	4.88	9	0	0	0	56.27	54.08

Note: EPM denotes equivalents per million

TABLE III

MAJOR ION CHEMISTRY
BOOTH QUARRY-GW-1-82

CATIONS

	Ca			Mg			Na			K				
Date	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	CATION TOTAL	ANION TOTAL
June 13, 1984	60	3.00	25	18	1.48	13	160	6.96	59	15	0.38	3	11.82	12.19
Nov 16, 1983	74	3.70	29	21	1.73	13	160	6.96	54	18	0.46	4	12.85	12.02
June 13, 1983	57	2.85	24	18	1.48	12	165	7.17	61	16	0.41	3	11.91	12.27
Nov 16, 1982	53	2.65	25	17	1.40	13	136	5.91	57	21	0.54	5	10.50	11.27
June 16, 1982	65	3.24	34	16	1.32	14	103	4.48	46	24	0.61	6	9.65	7.60
June 06, 1979	166	7.98	47	65	5.35	31	84	3.65	21	5	0.13	1	17.12	19.20
June 10, 1977	110	5.49	53	54	4.44	43	11	0.48	5	0	0	0	10.41	14.64

ANIONS

	Cl			SO_4			HCO_3			CO_3				
Date	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	ANION TOTAL	CATION TOTAL
June 13, 1984	92	2.59	21	163	3.40	28	310	6.20	51	0	0	0	12.19	11.82
Nov 16, 1983	95	2.68	22	150	3.13	26	285	5.70	47	26	0.52	4	12.02	12.85
June 13, 1983	93	2.62	21	180	3.75	31	295	5.90	48	0	0	0	12.27	11.91
Nov 16, 1982	63	1.77	16	170	3.54	31	274	5.48	49	24	0.48	4	11.27	10.50
June 16, 1982	42	1.18	16	102	2.12	28	191	3.82	50	24	0.48	6	7.60	9.65
June 06, 1979	110	3.10	16	370	7.70	40	512	8.40	44	0	0	0	19.20	17.12
June 10, 1977	100	2.82	18	206	4.29	29	460	7.54	51	0	0	0	14.64	10.41

Note: EPM denotes equivalents per million.

TABLE IV

MAJOR ION CHEMISTRY
BOOTH QUARRY - GW-2-77

CATIONS

Date	Ca			Mg			Na			K			CATION TOTAL	ANION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
June 13, 1984	100	5	50	42	3.46	34	32	1.39	14	6.00	0.15	2	10.00	9.69
Nov 16, 1983	136	6.80	56	45	3.70	30	35	1.52	12	7.50	0.19	2	12.22	10.17
June 13, 1983	107	5.35	53	40	3.29	32	33	1.43	14	5.9	0.15	1	10.22	11.07
Nov 16, 1982	129	6.45	63	30	2.47	24	28	1.22	12	4.6	0.12	1	10.26	10.16
June 16, 1982	115	5.74	51	46	3.78	34	34	1.48	13	6.3	0.16	1	11.16	8.05
Oct 13, 1981	97	4.84	47	43	3.54	34	39	1.70	17	7.8	0.20	2	10.28	11.36
June 09, 1981	100	4.99	48	47	3.87	37	32	1.39	13	6.2	0.16	2	10.41	11.13
June 12, 1980	92	4.59	45	44	3.62	36	40	1.74	17	6	0.15	2	10.10	10.97
Nov 21, 1979	98	4.89	46	49	4.03	38	37	1.61	15	8	0.20	2	10.73	10.81
Sept 12, 1979	130	6.48	53	49	4.03	33	34	1.48	12	9	0.23	2	12.23	11.08
June 06, 1979	100	4.99	45	55	4.53	42	34	1.48	13	7	0.18	2	11.17	12.28
Sept 21, 1978	94	4.79	48	45	3.70	37	35	1.52	15	0	0	0	10.01	11.61
May 08, 1978	85	4.24	47	40	3.29	37	30	1.30	15	5	0.13	1	8.96	12.87
Aug 22, 1977	128	6.23	56	27	2.22	20	54	2.35	21	10	0.26	2	11.06	12.28

ANIONS

Date	Cl			SO_4			HCO_3			CO_3			ANION TOTAL	CATION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
June 13, 1984	18	0.51	5	150	3.13	32	303	6.06	63	0	0	0	9.69	10.00
Nov 16, 1983	20	0.56	6	150	3.13	31	299	5.98	59	25	0.50	5	10.17	12.22
June 13, 1983	31	0.87	8	190	3.96	36	312	6.24	56	0	0	0	11.07	10.22
Nov 16, 1982	24	0.67	7	113	2.35	23	357	7.14	70	0	0	0	10.16	10.26
June 16, 1982	23	0.65	8	104	2.16	27	247	4.94	61	15	0.30	4	8.05	11.16
Oct 13, 1981	28	0.79	7	190	3.96	35	403	6.61	58	0	0	0	11.36	10.28
June 09, 1981	28	0.79	7	192	4.00	36	387	6.34	57	0	0	0	11.13	10.41
June 12, 1980	27	0.76	7	192	4.00	36	379	6.22	57	0	0	0	10.97	10.10
Nov 21, 1979	28	0.79	7	180	3.75	35	383	6.28	58	0	0	0	10.81	10.73
Sept 12, 1979	26	0.73	7	180	3.75	34	403	6.60	60	0	0	0	11.08	12.23
June 06, 1979	26	0.73	6	190	3.95	32	464	7.60	62	0	0	0	12.28	11.17
Sept 21, 1978	26	0.73	6	145	3.02	26	479	7.86	68	0	0	0	11.61	10.01
May 08, 1978	25	0.70	5	210	4.37	34	476	7.80	61	0	0	0	12.87	8.96
Aug 22, 1977	40	1.13	9	217	4.52	37	405	8.64	54	0	0	0	12.28	11.06

TABLE V

MAJOR ION CHEMISTRY
BOOTH QUARRY - 09-6-82

CATIONS

Date	Ca			Mg			Na			K			CATION TOTAL	ANION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
June 13, 1984	128	6.40	43	44	3.62	24	101	4.39	29	24	0.62	4	15.03	15.26
Nov 16, 1983	155	7.75	45	48	3.95	23	106	4.61	27	29	0.74	4	17.05	16.03
June 13, 1983	124	6.20	40	45	3.70	23	117	5.09	32	29	0.74	5	15.73	16.77
Nov 16, 1982	120	6.00	37	45	3.70	23	123	5.35	34	35	0.90	6	15.95	16.09
June 16, 1982	127	6.34	39	45	3.70	23	119	5.18	32	46	1.18	7	16.40	14.45

ANIONS

Date	Cl			SO_4			HCO_3			CO_3			ANION TOTAL	CATION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
June 13, 1984	58	1.63	11	316	6.58	43	352	7.04	46	0	0	0	15.26	15.03
Nov 16, 1983	60	1.69	11	330	6.88	43	348	6.96	43	25	0.50	3	16.03	17.05
June 13, 1983	66	1.86	11	370	7.71	46	359	7.2	43	0	0	0	16.77	15.73
Nov 16, 1982	65.5	1.85	11	333	6.94	43	333	6.7	42	30	0.60	4	16.09	15.95
June 16, 1982	67	1.89	13	350	7.28	50	240	4.8	33	24	0.48	3	14.45	16.40

Note: EPM denotes equivalents per million

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TABLE VI

MAJOR ION CHEMISTRY
BOOTH QUARRY - OW-8-77

CATIONS

Date	Ca			Mg			Na			K			CATION TOTAL	ANION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
June 13, 1984	117	5.85	74	15	1.23	16	16	0.70	9	4.3	0.11	1	7.89	7.94
Nov 16, 1983	138	6.90	72	15	1.23	13	31	1.35	14	1.5	0.04	0	9.52	7.95
June 13, 1983	100	5.00	68	13	1.07	15	29	1.26	17	1.5	0.04	0	7.37	7.91
Nov 16, 1982	122	6.10	70	16	1.32	15	30	1.30	15	1.7	0.04	0	8.76	8.66
June 16, 1982	133	6.64	71	14	1.15	12	35	1.52	16	1.4	0.04	0	9.35	7.50
Oct 13, 1981	127	6.34	68	17	1.40	15	34	1.48	16	2.3	0.06	0	9.28	10.29
June 09, 1981	124	6.19	69	15	1.23	14	34	1.48	17	1.6	0.04	0	8.94	9.10
June 12, 1980	112	5.59	65	16	1.28	15	40	1.74	20	2	0.05	1	8.66	9.45
Nov 21, 1979	128	6.38	67	16	1.32	14	41	1.78	19	2	0.06	1	9.54	9.71
Sept 12, 1979	150	7.48	70	15	1.23	12	43	1.87	18	4	0.10	1	10.68	9.30
June 16, 1979	140	6.98	67	18	1.48	14	43	1.87	18	2	0.05	0	10.38	10.80
Sept 21, 1978	118	5.89	68	15	1.23	14	36	1.57	18	0	0	0	8.69	20.05
May 08, 1978	280	13.97	65	15	1.23	6	145	6.30	29	1	0.03	0	21.53	14.15
Aug 22, 1977	180	8.98	56	53	4.36	27	62	2.70	17	5	0.13	1	16.16	13.46

ANIONS

Date	Cl			SO_4			HCO_3			CO_3			ANION TOTAL	CATION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
June 13, 1984	47	1.32	17	90	1.88	23	237	4.74	60	0	0	0	7.94	7.89
Nov 16, 1983	23	0.65	8	100	2.08	26	239	4.78	60	22	0.44	6	7.95	9.52
June 13, 1983	29	0.82	10	105	2.19	28	245	4.90	62	0	0	0	7.91	7.37
Nov 16, 1982	24	0.68	8	94	1.96	23	301	6.02	69	0	0	0	8.66	8.76
June 16, 1982	32	0.90	12	80	1.66	22	230	4.60	61	17	0.34	5	7.50	9.35
Oct 13, 1981	28	0.79	8	120	2.50	27	427	7.00	68	0	0	0	10.29	9.28
June 09, 1981	37	1.04	11	120	2.50	27	339	5.56	61	0	0	0	9.10	8.94
June 12, 1980	34	0.56	10	140	2.91	31	340	5.58	59	0	0	0	9.45	8.66
Nov 21, 1979	35	0.99	10	136	2.83	29	360	5.90	61	0	0	0	9.71	9.54
Sept 12, 1979	35	0.99	11	140	2.91	31	329	5.40	58	0	0	0	9.30	10.68
June 16, 1979	46	1.30	12	130	2.71	25	415	6.80	63	0	0	0	10.80	10.38
Sept 21, 1978	51	1.44	7	538	11.20	56	453	7.42	37	0	0	0	20.05	8.69
May 08, 1978	85	2.39	17	200	4.16	29	464	7.60	54	0	0	0	14.15	21.53
Aug 22, 1977	105	2.96	22	197	4.10	30	390	6.40	48	0	0	0	13.46	16.16

Note: EPM denotes equivalents per million

TABLE VII

SURVEY OF WATER TABLE AT BOOTH QUARRY ASH DISPOSAL SITE
JUNE, 1982 TO JUNE, 1984

Observation Well Location	Elevation* of Ground Level (m)	Elevation* of Water Table (m)				
		82 06 21	82 11 05	83 06 08	83 11 09	84 06 08
OW-1-82	103.44	100.81	101.05	101.19	100.91	101.15
OW-2-77	102.07	101.36	101.58	101.32	100.85	101.14
OW-6-82	101.51	99.08	99.15	99.43	99.31	99.51
OW-7-82	101.41	97.00	97.03	97.36	N.D.**	N.D.**
OW-8-77	102.25	100.46	100.55	100.40	100.14	100.27
Central Sump	101.46	96.47	96.87	97.56	97.79	98.71

* All elevations refer to geodetic datum.

** N.D. denotes not determined - observation well practically dry.

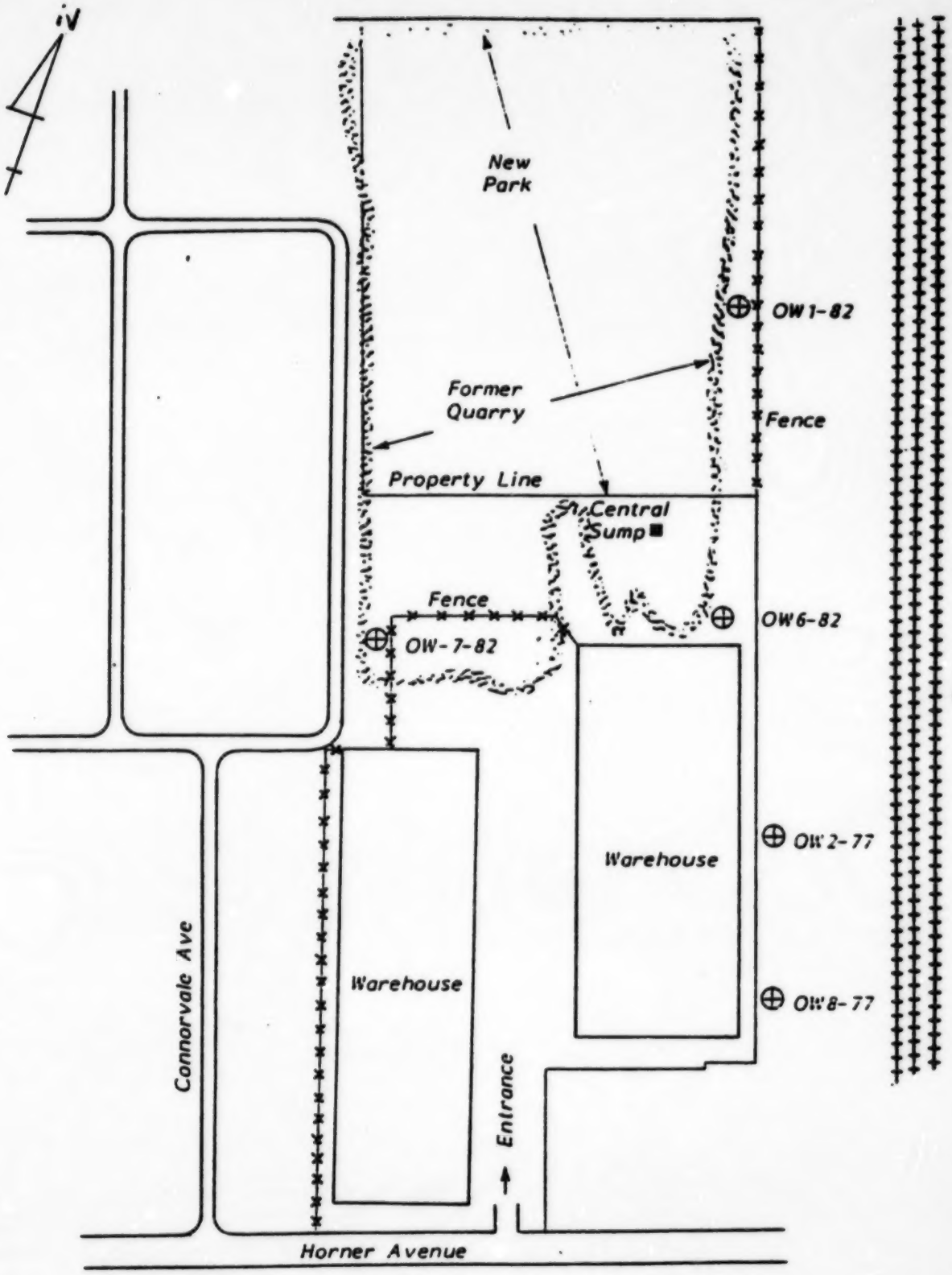

FIGURE 1

BOOTH QUARRY ASH DISPOSAL SITE
(Not to Scale)

158887-RD
84-389

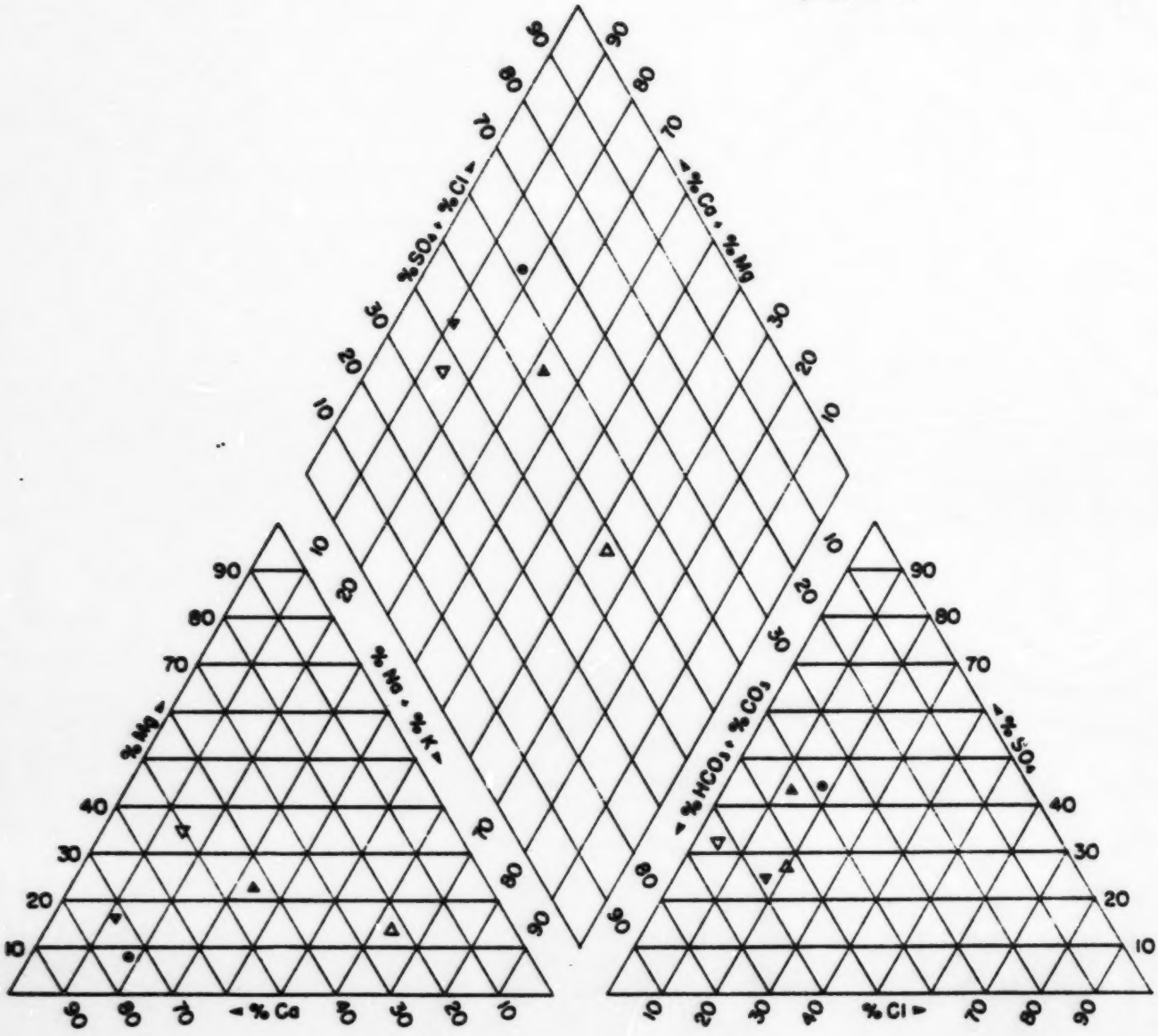

FIGURE 2

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
1984 (JUNE) - ALL LOCATIONS

167333 RD

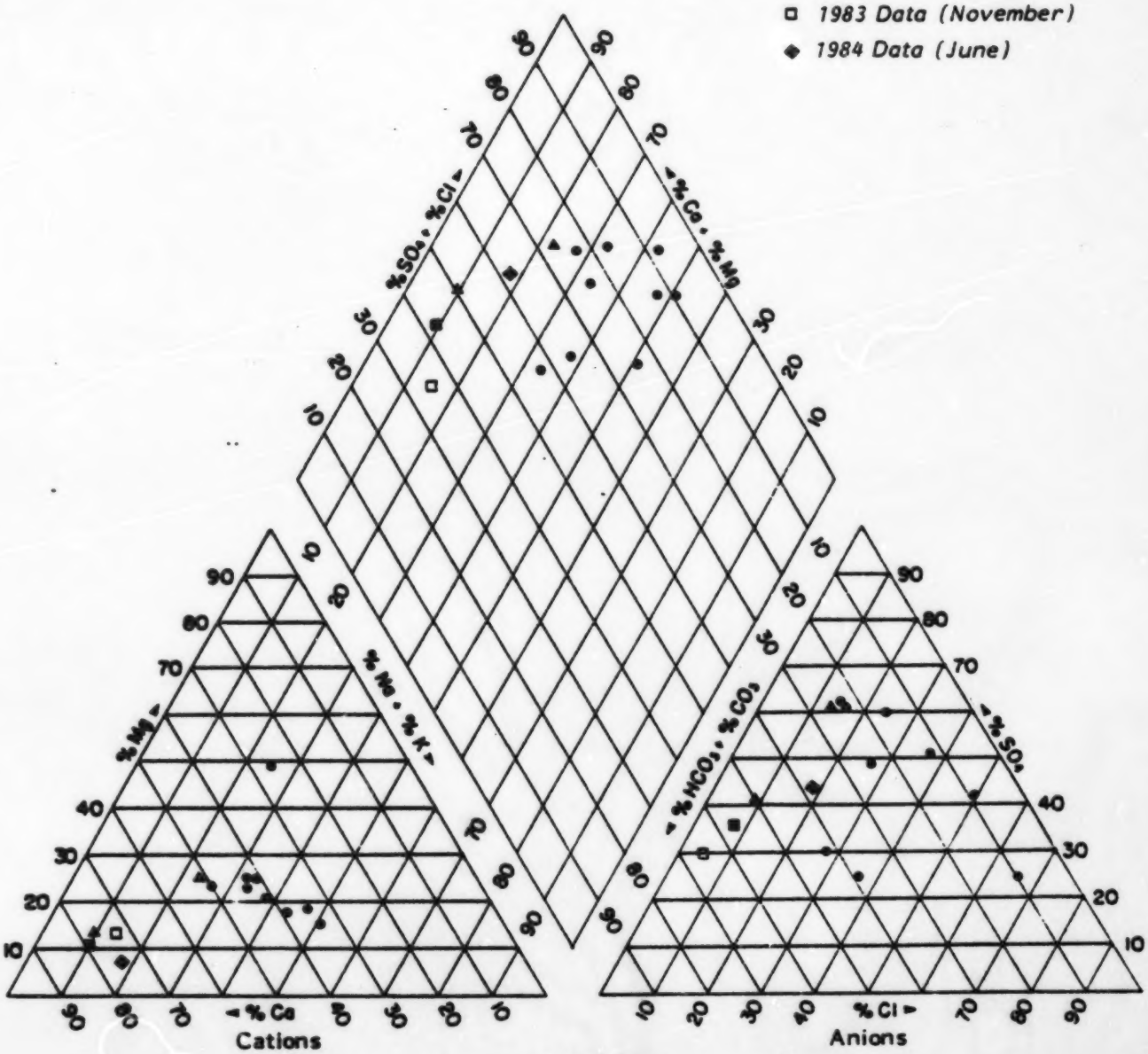

FIGURE 3

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: CENTRAL SUMP

164626 RD

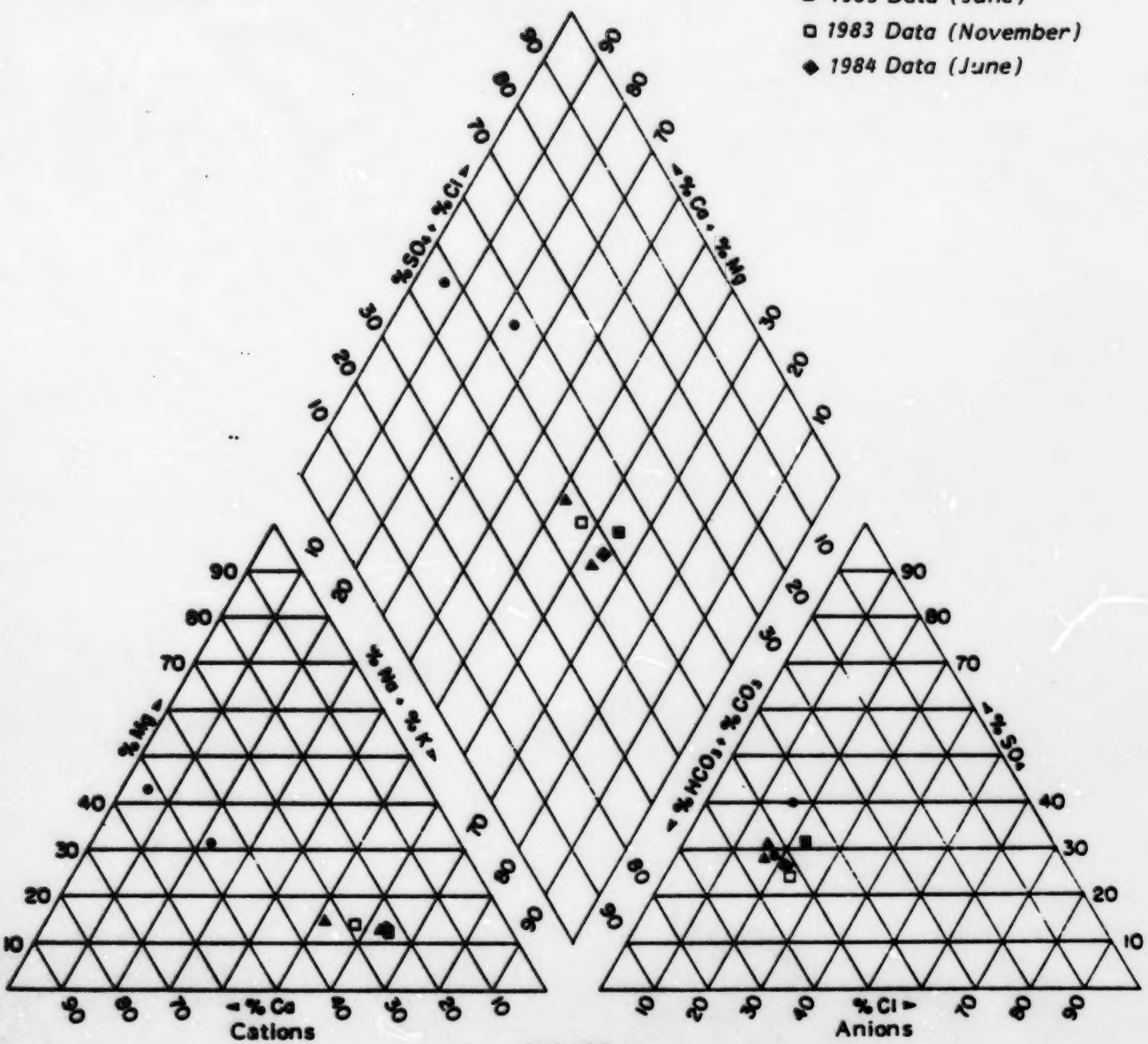

FIGURE 4

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: OW-1-82

164627 RD

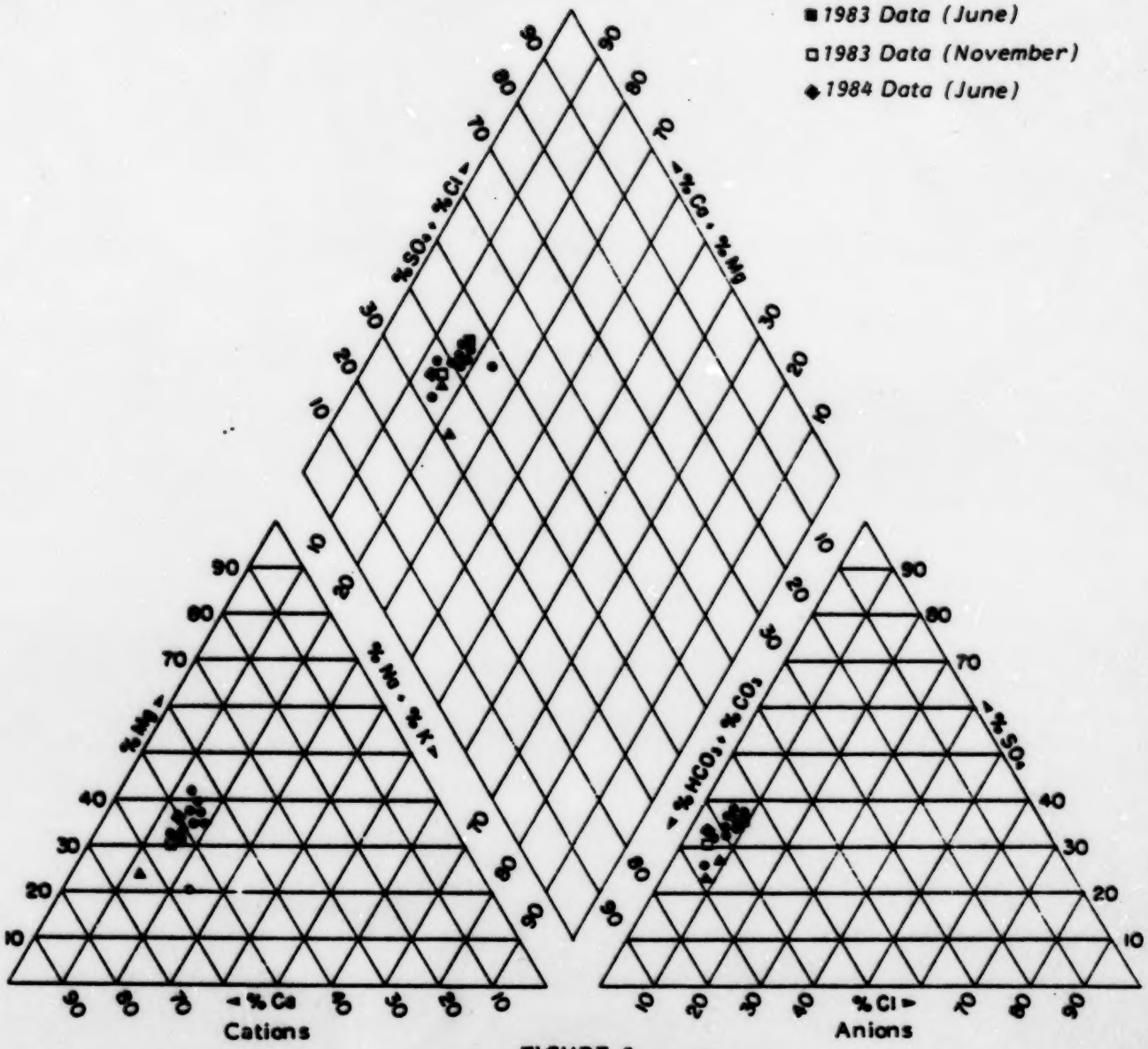

FIGURE 5

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: OW-2-77

164628 RD

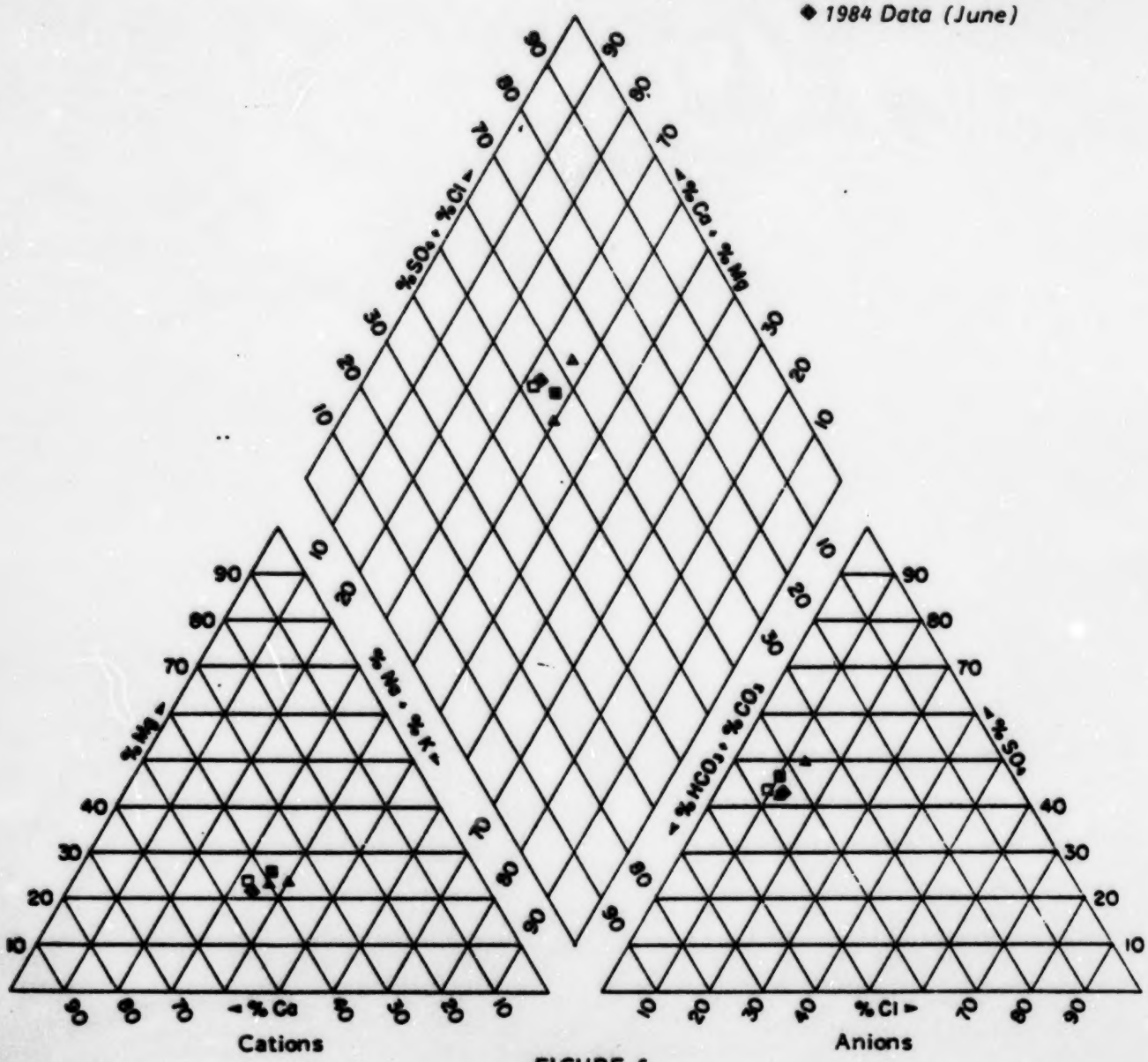

FIGURE 6

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: OW-6-82

164629 RD

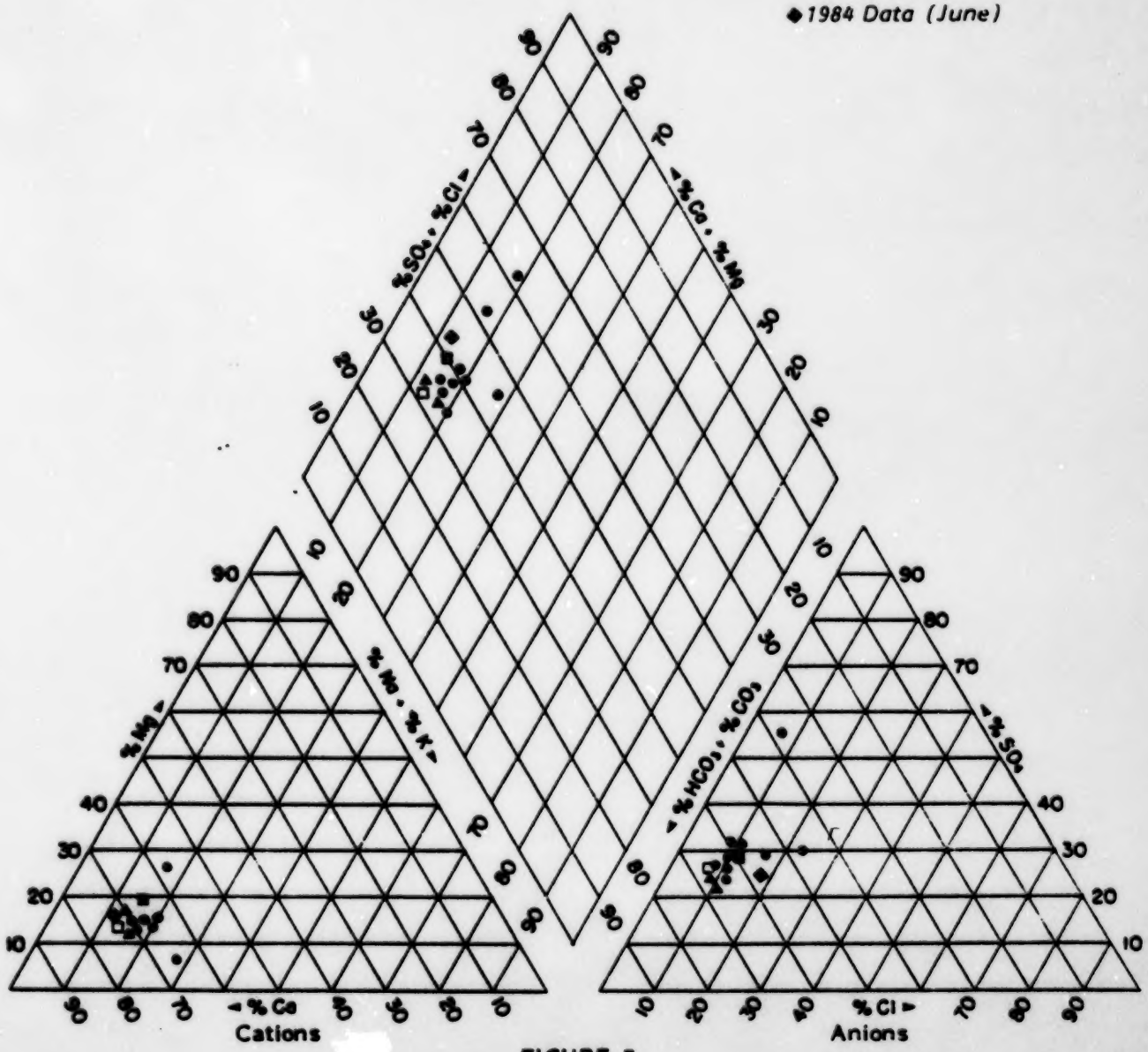

FIGURE 7

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: OW-8-77

164630 RD